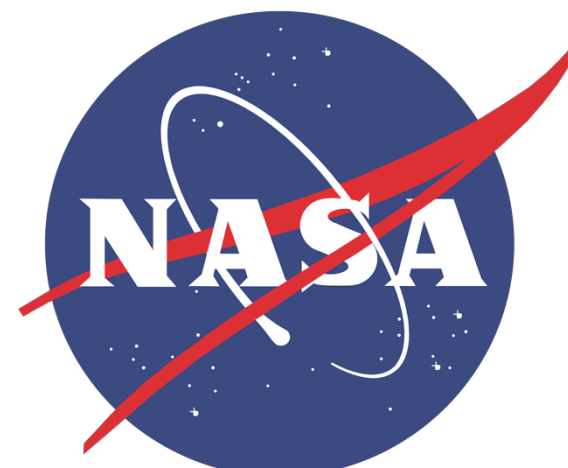# GPM Path Attenuation Estimation and Validation Activities

Stephen L. Durden and Simone Tanelli

Jet Propulsion Laboratory, California Institute of Technology

Email: sdurden@jpl.nasa.gov

Panel 1

Introduction

- This work has focused on the GPM Path Integrated Attenuation (PIA), including the assumptions that go into its estimate
- For both GPM and TRMM, the PIA is based on the Surface Reference Technique
  - Compare measurement of surface in rain with appropriate reference
  - Difference is two-way PIA
- Surface return is investigated to understand SRT error characteristics
  - Impact of land type and vegetation
 - Impact of rain on both land

Panel 2

- To test the impact of surface type on the SRT, we expanded classes in operational algorithm
  - Operational: land, sea, coastal
  - New: sea, coastal, plus expanded land categories
- The expanded land categories are based on unsupervised clustering of GPM data
- Built database of GPM Ku-band and Ka-band sigma0 versus incidence angle (for matched swath)
- Concatenating all Ku and Ka-band measurements at a location yields at 26-element vector
- PCA was used to reduce to three components (explained about 98% of variance)
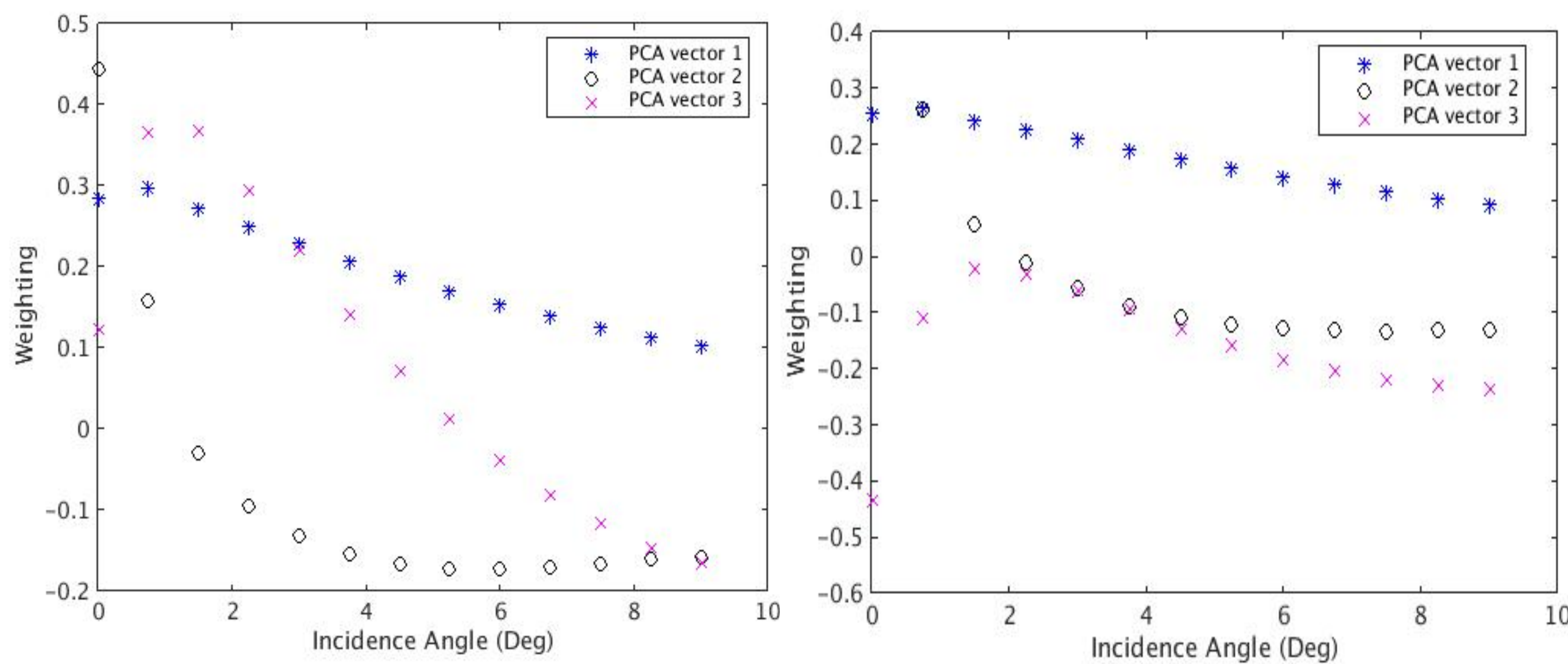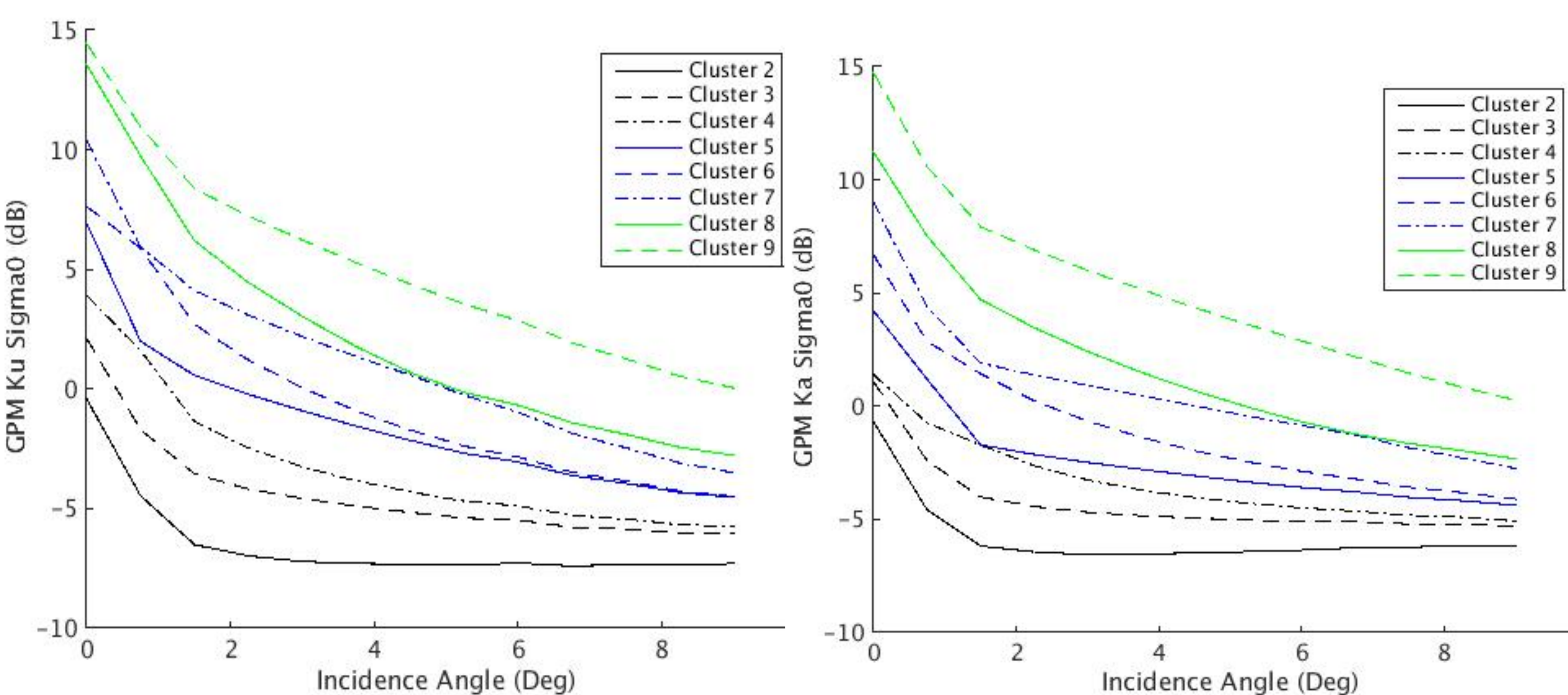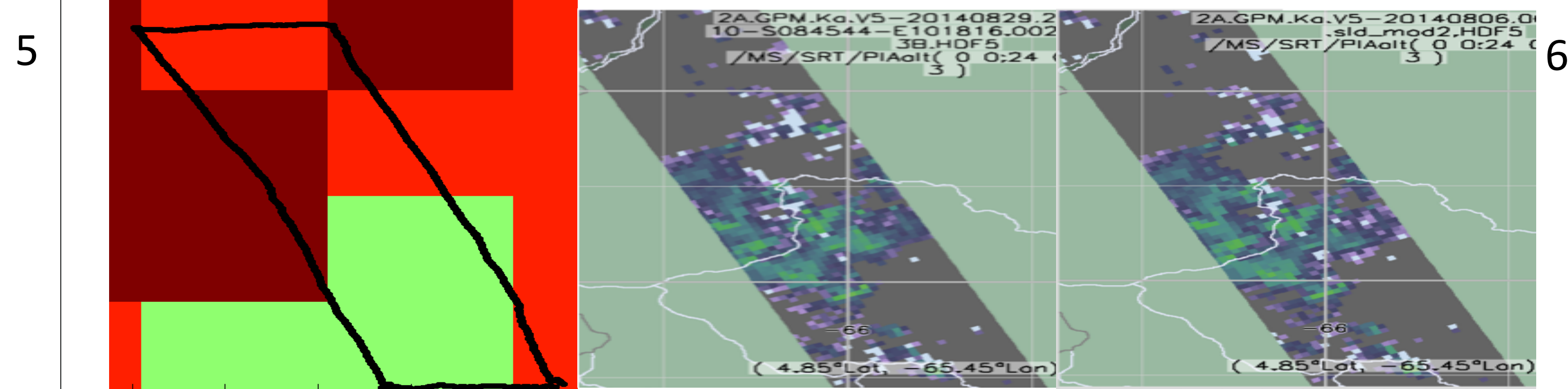
Panel 3

Results of PCA on GPM DPR data. The weighting is that applied to the data over incidence angle to calculate the corresponding principal component. Left is Ku-band, Right is Ka-band

Panel 4

Global classification using GPM Ku- and Ka-band data (after PCA)

Resolution is 0.5°

Panel 5
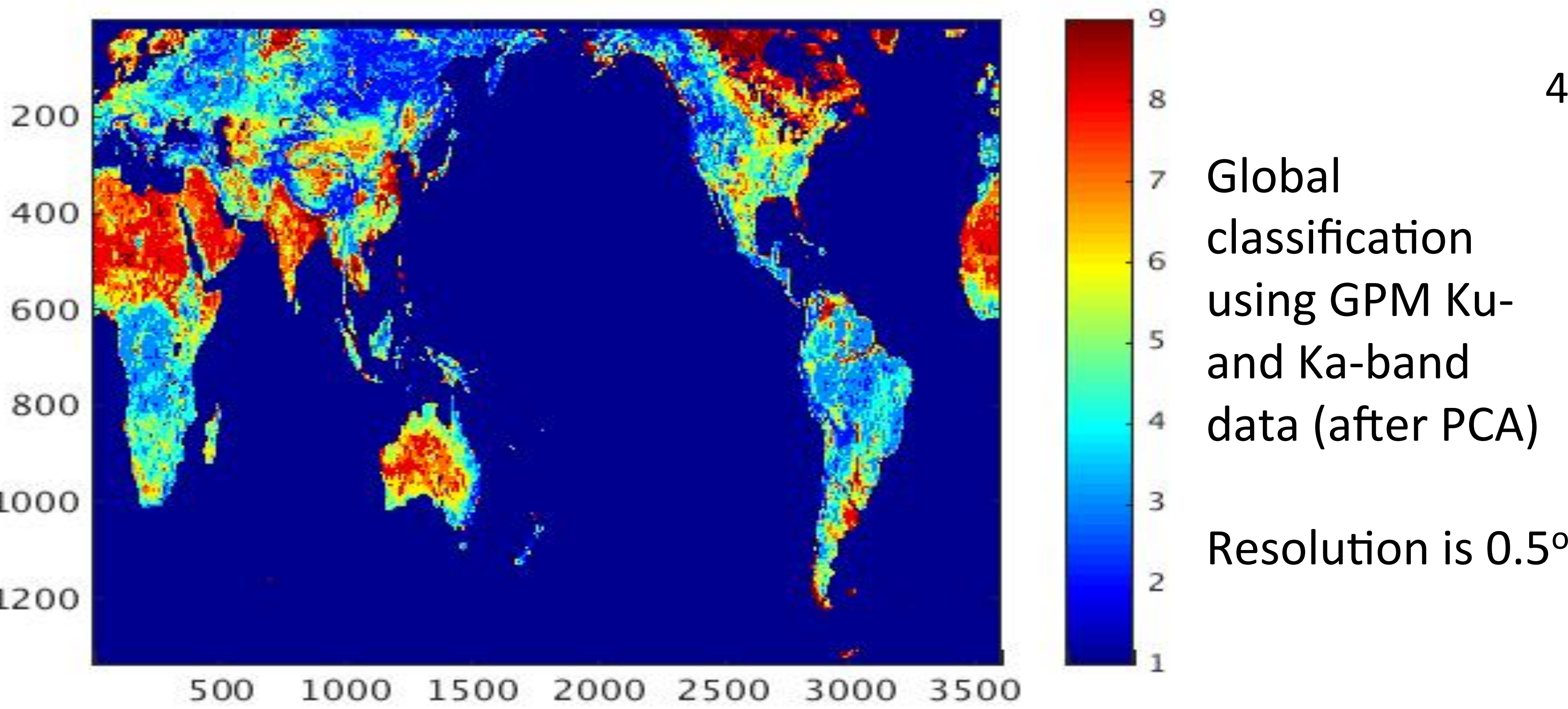
σ0 versus incidence for each cluster. Left, Ku. Right, Ka.

Panel 6

Left: classes using a 6-land class clustering, black box is DPR-Ka swath. Comparison of the PIA from the SRT using the operational algorithm (center) and the class-based SRT with 6 classes at right. The location is northern South America. (Processed by **R. Meneghini** of GSFC.)
6 classes were used to reduce noise; will re-do with longer GPM record.

Panel 7

- Current assessment of surface-type impact on SRT:
  - operational along-track SRT average error due to varying land type small; could be large error in isolated cases
  - Planning to re-do with higher-res classification
- Most of the variability in the SRT-estimated PIA is likely due to variations in backscatter, especially as moisture changes
- Collaborated with **J. Turk** (who did the data analysis)
  - Piggybacked on his work on Oscat and rainfall effect on surface
  - Used his database of Nexrad data to examine sigma0 from TRMM versus rain conditions as seen by Nexrad over ConUS
  - Applied land classification (using TRMM data) to better understand the effects of current and previous rain on sigma0
    - Likely combined effect of vegetation and soil moisture
- Planning to extend to higher latitudes using GPM data
- (see talk by Turk et al.)

Panel 8

- In doing the PIA work, we also investigated GPM data quality; we and colleagues at GSFC noted negative DFR (Ku-Ka in dB).
- Left figure shows the DFR observed in range bins well above the melting level versus the maximum reflectivity at Ku-band at the same horizontal location. Colors show the Ku-band reflectivity at the same horizontal and vertical location of the DFR measurement. All the really negative DFR values occurs for reflectivities less than about 10 dBZ.
- Performed Monte Carlo simulation of DFR, given the single pulse sensitivity of each frequency and the number of samples averaged. Large DFR std dev at low Z, so expect some negative DFR.

Panel 9
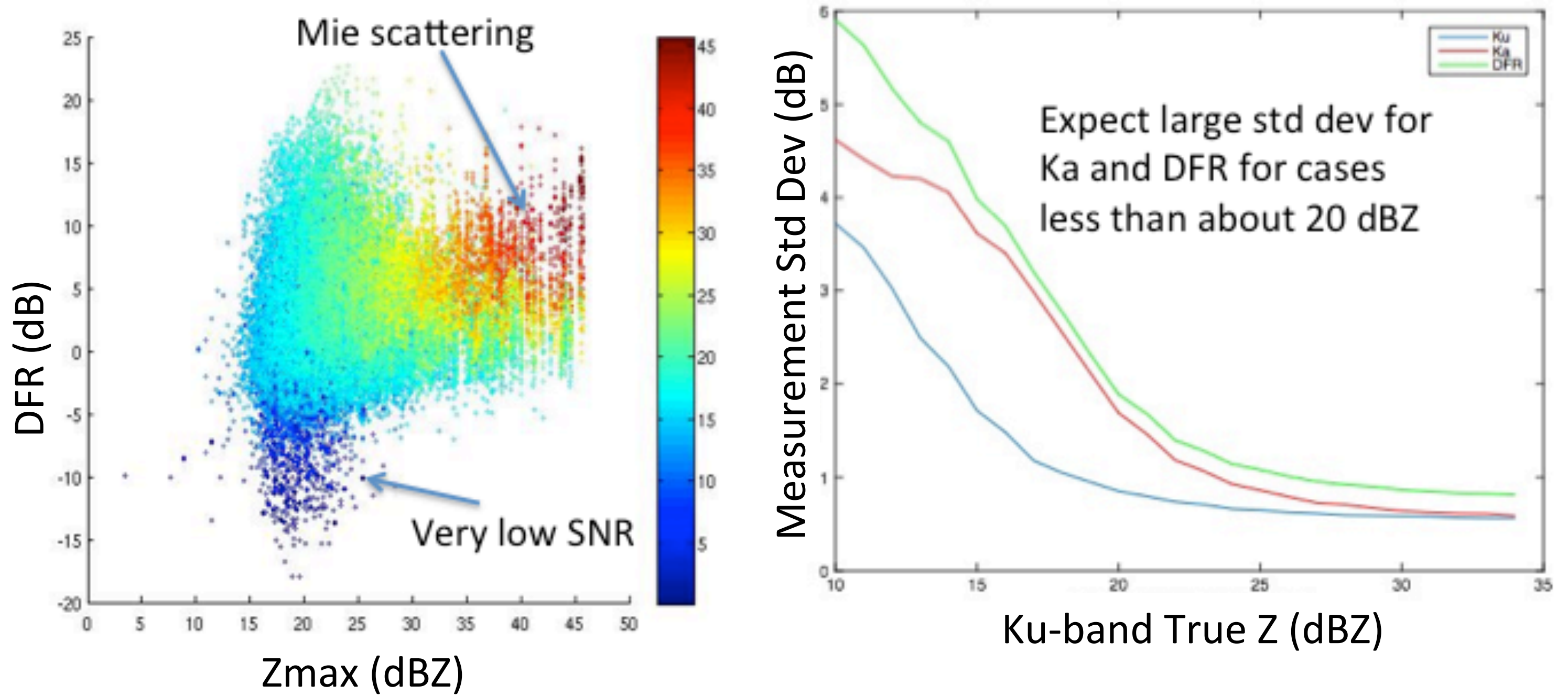
- Left figure shows the V03 GPM Ku-band data versus incidence
- Minimum scatter (i.e., minimum wind sensitivity) occurs near 10° incidence, as seen in literature
- Right figure shows data with a proposed calibration change
- The values are almost 2 dB higher; actual V04 now planned to be ~same as V03 (JAXA presentation, July 2015)